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(54) **Apparatus for stopping a sleeping person from snoring**

(57) Apparatus for stopping a sleeping person from snoring comprises a microphone 7 for receiving snoring sounds connected to a transmitter 15 which wirelessly transmits signals corresponding to the snoring sounds; and a mobile unit 3 comprising a receiver 17 which receives the signals emitted by the said transmitter and a voltage source 23, 25 controllable by the received signals and connected to two electrodes 5 in contact with a sleeping person. A stimulus voltage is applied across the electrodes to stop the sleeping person from snoring as soon as a preset response level is exceeded. The mobile unit 3 may include a housing adapted to be worn on the wrist like a wrist watch, which housing carries the electrodes 5 and may accommodate batteries. The transmitted signals are preferably ultra-sonic signals.

FIG.1

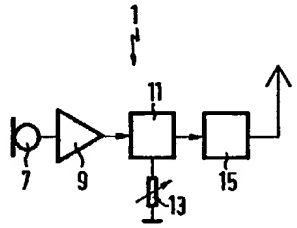

FIG.2

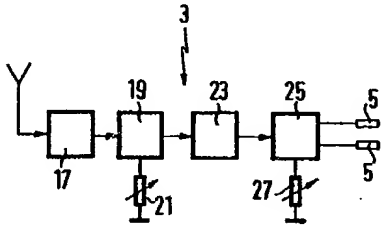

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FIG. 1

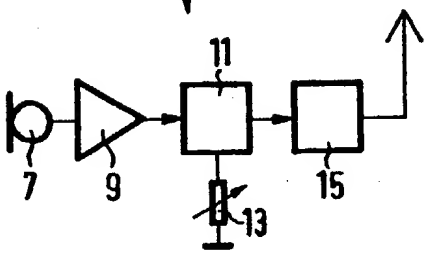


FIG. 2

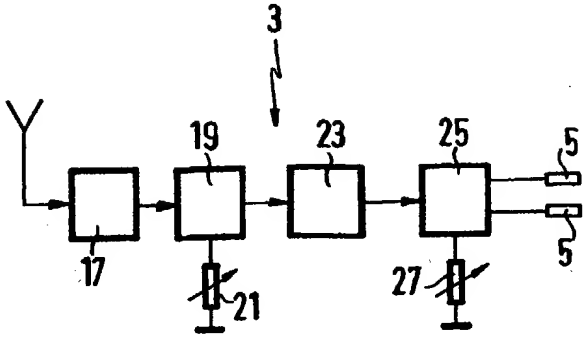


FIG. 3

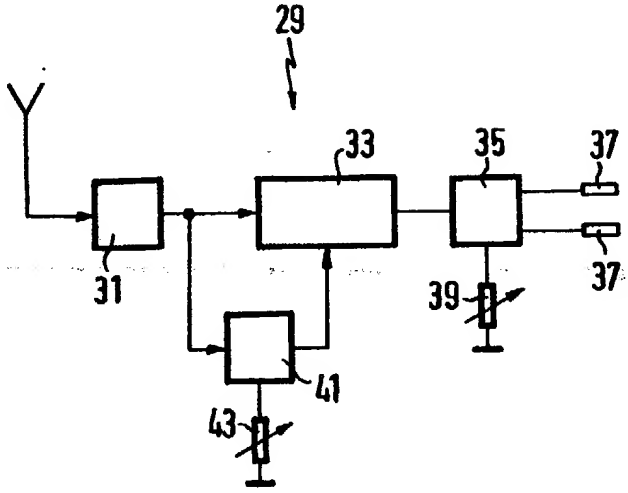
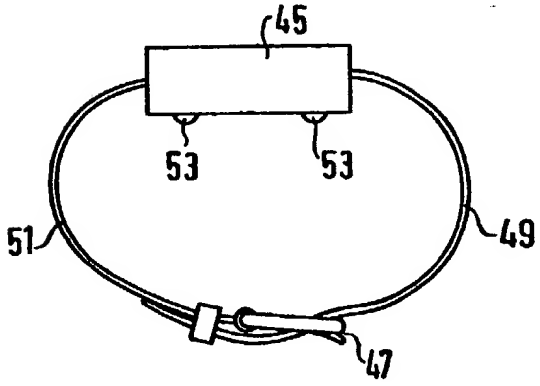


FIG. 4



SPECIFICATION

Apparatus for stopping a sleeping person from snoring

This invention refers to apparatus for stopping a sleeping person from snoring, of the type comprising a microphone for receiving snoring sounds and an interfering device controllable by signals from the said microphone.

Such an anti-snoring device is disclosed in German Patent specification DE—AS 1 151 347. The microphone recives the snoring sounds and actuates an electrical motor via an electrical control, to change the position of the sleeper's head to cause him to stop snoring. This known device however requires elaborate constructional changes to be performed on the bed, and generally is complicated.

It is the object of the present invention to provide apparatus for stopping a sleeping person from snoring, which apparatus is mobile and the receiver component of which is readily movable independent of the sleeping position of the sleeper.

This object is achieved by providing a microphone unit separate from the interfering unit, which interfering unit is wirelessly operable from the microphone unit and is associated with electrodes to pass current through the sleeping person when snoring occurs.

To this end the invention provides apparatus for stopping a sleeping person from snoring, comprising a microphone for receiving snoring sounds and an interfering device controlled by signals from the said microphone: characterised in that a transmitter is connected to the output of the microphone and is adapted to wirelessly transmit signals corresponding to snoring sounds; and in that the said interfering device comprises a receiver arranged to receive signals emitted by the said transmitter, and a voltage source controllable by the received signals and connected with the said receiver to form therewith a mobile unit and two electrodes connected to the output of said voltage source and adapted to be brought into touching contact with a sleeping person.

The receiver + voltage source unit built may for example be incorporated in a common housing and arranged to be worn on the arm of the sleeping person by means of straps or the like, for instance in the manner of a wrist watch. The receiver unit is separate from the microphone which is preferably also built into one unit with the voltage source and which may be positioned for example at the head end of the bed. If the microphone receives snoring sounds of a level exceeding a preset sound intensity, the voltage source is switched on causing a stimulus current to flow between the two spaced electrodes and in touching contact with the skin of the sleeper continues to flow across the electrodes until the person stops snoring. By such an arrangement the sleeper is not connected to the microphone by cable or other means thus providing for freedom of movement while he sleeps. The microphone furthermore is located in a fixed position and does not move with the sleeper and therefore does not receive any of the rustling noises that would occur if the microphone were built with the electrodes in one unit arranged to move together with the sleeper.

The wireless signals may for example be ultrasonic signals generated by an ultra-sonic transmitter, the receiver being an ultra-sonic receiver. The power output of such ultra-sonic transmitters can be maintained at a low level thus preventing interference with receivers in adjacent rooms. Such interference could for example lead to disturbances in the operation of radio transmitters.

To cause the stimulus current flow only when a predetermined snoring sound intensity is exceeded, the transmitter may be arranged to generate amplitude modulated signals in dependence of the sound intensity of the snoring sound and a threshold value stage may be connected to the output end of the receiver and arranged to control the voltage output of the voltage source and to respond at a response level adjustable to correspond to a desired snoring sound level. In this embodiment the threshold value stage is integrated into the receiver + voltage source unit; this may be of advantage particularly if the output voltage of the voltage source is to be controlled in dependence of the snoring sound intensity to make the output voltage increase with increasing snoring sound intensity.

As an alternative a threshold value stage arranged to control the transmitter and responding with an adjustable trigger level corresponding to a desired snoring sound intensity may be connected to the output end of the microphone; the transmitter may be arranged to generate a control signal independent of the intensity of the snoring sounds, to switch on the voltage source when the trigger signal is exceeded. This embodiment evaluates the snoring sound intensity within the microphone + transmitter unit, with the result, that only a small number of components must be contended with on the side of the receiver + voltage source unit, the size and the current consumption of this unit thus being beneficially influenced.

The device is meant to respond to snoring sounds only, and in particular to the sound of a particular person; not to other noises in the environment, though. For this reason a band pass filter is preferably inter-connected between the microphone and the voltage source and arranged to let through snoring sound frequencies only. To satisfy the aforementioned requirements in regards to low requirements of space and current consumption and band pass filter should preferably be interconnected between the microphone and the transmitter; another possibility would be to connect it to the output end of the receiver. The band pass filter should preferably be narrow banded to enable it to suppress the frequencies of the environmental

noises, as much as possible. Since the snoring sounds may be of varying frequencies, the pass band filter should preferably be adjustable. Band pass filters with adjustable pass band width, or preferably with adjustable middle frequency, may be built into active filters that need comparatively little space.

The output voltage of the voltage source should preferably lie between approximately 20 volts and 40 volts. The mains-independent battery or accumulator voltage of the receiver + voltage source unit lies as a rule considerably below these voltage values. This low operating voltage could be transformed into higher voltage values via a transformer, by inverting or chopping. To be sure, the transformer would require considerable space on the receiver side. Its comparatively large weight and its relatively large production costs are relevant items in this context. Therefore, a preferred embodiment has its voltage source include a voltage amplifier circuit energized by a square pulse generator, the electrodes being connected to the output terminals of said circuit. The voltage multiplier circuit preferably generates at its output terminals a DC-voltage balanced to ground. The voltage multiplier circuit is preferably executed as a cascade circuit with diodes. However, voltage multiplier circuits operating in accordance to the shopper-amplifier principle may also be used.

Voltage multiplier circuits of this kind furthermore show the advantage that their output voltage may be controller comparatively simply. This is particularly desirable in a case, in which the output voltage is to be controllable in dependence of the amplitude of the received signal, said amplitude representing the sound intensity of the snoring sound; the control shall be such as to cause the stimulus current acting upon the sleeper to increase as the sound intensity of the snoring sound increases.

The receiver and the voltage source are preferably built into a common housing provided with an arm fastening strap or the like, the two electrodes, when in use, being spaced from and insulated with respect to one another on the side facing the arm of the sleeper. The receiver + voltage source unit may be worn analogous to a wrist watch and does not hinder the sleeper in his sleep.

The electrodes may be made of electrically conducting hard rubber, or of nickel, or of silver, or may be silver/silver chloride electrodes. Since some applications may require the use of an electrolyte gel for improving the contact between the electrodes and the skin, it may be of advantage to use electrodes of porous graphite. Practice has shown that it is sufficient to only wet such electrodes with water to achieve the improvement in contact required.

The invention is hereinafter described in more detail with reference to the accompanying drawings, of which

Figure 1 is a schematic circuit diagram of a microphone unit comprising a microphone and a transmitter;

Figure 2 is a schematic circuit diagram of a receiver unit comprising a receiver and a voltage source;

Figure 3 is schematic representation of a further embodiment of a receiver unit comprising a receiver and a voltage source; and

Figure 4 is a schematic representation of a receiver unit comprising a receiver and a voltage source and fastenable in the manner of a wrist watch on the arm of a sleeping person.

The apparatus of the invention for stopping a sleeping person from snoring includes a microphone unit 1 (Figure 1) comprising a microphone plus transmitter adapted to be set in position to receive snoring sounds, for example at the bed head end of a sleeping person, and a separate receiver unit 3 (Figure 2) comprising a voltage source and two electrodes 5 spaced from each other and in touching contact with the sleeper. A stimulus current flows between the electrodes 5 when snoring sounds occur, the sleeper responding to this current stimulus by stopping snoring.

The microphone unit 1 comprises a microphone 7 connected to an active band pass filter 11 via a preamplifier 9. The active band pass filter 11 may be designed as a frequency dependent negative and/or positive feed-back connected amplifier, in which instance resistance condenser circuits with suitable frequency response characteristics may be used to advantage as frequency dependent members. The pass band width of the band pass filter 11 is relatively narrow. Its middle frequency, which may be set for example to values between 10 and 100Hz, is adjustable via an adjusting member, e.g. a potentiometer placed in one of the frequency dependent circuits, thereby adjusting the filtering properties of the band pass filter 11 to the frequency range of the snoring sounds. The output signals of the band pass filter 11 are fed to an ultra-sonic transmitter 15 includes in the microphone unit, which emits ultrasonic signals of amplitudes proportional to the sound intensities of the snoring sounds.

An ultra-sonic receiver 17 of the receiver unit receives the emitted ultra-sonic signals and feeds signal parts proportional to the sound intensities to a threshold value stage 19, the threshold value level of which may be set via an adjusting member 21 to a desired trigger level for the stimulus current. In response to exceeding this trigger level the threshold value stage 19 sets a square pulse generator 23 free, the output square pulses of which are fed to a voltage multiplier circuit 25. The voltage multiplier circuit 25 may be a diode cascade balanced to ground for example, such as a Greinacher circuit. Equally suitable may be an amplifier circuit with terminals preferably balanced to earth, said circuit to be controlled by the square pulse generator in the manner of a chopper amplifier. The voltage multiplier circuit 25 comprises an adjusting member 27 via which the output voltage between the electrodes 5 may be set within the range of 20 to 40 volts. The voltage

source energizing the receiver + voltage source unit 3 is not shown in Figure 2. The source in question may be a battery or an accumulator battery used to guarantee an operation independent of the power mains.

Figure 3 shows a circuit diagram of a further embodiment of a receiver plus voltage source unit 29, which differs from the receiver plus voltage source unit 3 of Figure 2 in that a square pulse generator 33 is connected to an ultra-sonic receiver 31, the output voltage or the output frequency of the generator 33 being controllable in dependence of the output signals of the ultra-sonic receiver 31. Furthermore, a voltage multiplier circuit 35 having its output terminals preferably balanced to earth and connected with two electrodes 37 is connected to the square pulse generator 33. The square pulse generator 33 controls the output voltage of the voltage multiplier circuit 35 in a way to make the output voltage increase with increasing sound intensity of the snoring sounds. The basic value of the output voltage may be set via an adjusting member 39 of the voltage multiplier circuit 35. On the output end of the ultra-sonic receiver 31 is furthermore connected a threshold value stage 41, which sets the square pulse generator 33 and thus initiates the stimulus current flow as soon as a predetermined response level is exceeded. This response level may be set via an adjusting member 43 of the threshold value stage 41.

In the embodiments hereinbefore described the microphone plus transmitter unit 1 emits ultra-sonic signals having amplitudes proportional to the sound intensities of the snoring sounds. The threshold value stage which sets the response level is provided on the side of the receiver plus voltage source unit 3, 29. As an alternative the threshold value stage may be provided on the side of the microphone plus transmitter unit. In this instance the transmitter only emits switch-on signals having amplitudes independent of the sound intensities of the snoring sounds. A wireless transmitter and receiver may equally be used instead of the ultra-sonic transmitter and receiver.

Figure 4 is a plan view of the receiver plus voltage source unit. This unit comprises a common housing 45 for the components of the units described with reference to Figures 2 and 3. Two straps 49, 51 which may be connected one with another by means of a buckle closure 47 to form a closed ring, are provided on opposite sides of the housing 45, in a way to enable the latter to be fastened to the wrist of the sleeper. Two electrodes 53 open toward the outside are provided on the side of the housing intended to face the sleeper's arm, spaced apart by approximately 20 mm and insulated one from another. The illustrated embodiment shows the electrodes 53 having a spheroidal surface protruding beyond the outer surface of the housing 45. The protruding parts of the electrodes 53 consist of porous graphite, which may be wetted with water for improving its contact properties.

Other embodiments of electrodes may have different shapes e.g. flat outer surfaces. Similarly, other materials may be used for the contact surfaces of the electrodes, e.g. electrically conducting hard rubber, nickel, or silver, or silver/silver chloride material.

CLAIMS

1. Apparatus for stopping a sleeping person from snoring, comprising a microphone for receiving snoring sounds and an interfering device controller by signals from the said microphone: characterised in that a transmitter (15) is connected to the output of the microphone (9) and is adapted to wirelessly transmit signals corresponding to snoring sounds; and in that the said interfering device comprises a receiver (17, 31) arranged to receive signals emitted by the said transmitter, and a voltage source (23, 25; 33, 35) controllable by the received signals and connected with the said receiver to form therewith a mobile unit (3, 29, 45), and two electrodes (5, 37, 53) connected to the output of said voltage source and adapted to be brought into touching contact with a sleeping person

2. Apparatus as claimed in Claim 1, characterised in that the transmitter is an ultra-sonic transmitter and the receiver is an ultra-sonic receiver.

3. Apparatus as claimed in Claim 1 or Claim 2, characterised in that the transmitter is adapted to emit amplitude modulated signals in dependence on the sound intensity of snoring sounds, and a threshold value stage (19, 41) controlling the voltage output of the voltage source (23, 25; 33, 35) and having a response level adjustable to correspond to a desired snoring sound level is connected to the output end of the receiver (17, 31).

4. Apparatus as claimed in Claim 1 or Claim 2, characterised in that a threshold value stage arranged to control the transmitter and having an adjustable trigger level corresponding to a desired snoring sound intensity, is connected to the output end of the microphone, and in that the transmitter emits a control signal independent of the intensity of the snoring sounds, to switch on the voltage source when the trigger signal level is exceeded.

5. Apparatus as claimed in Claim 1 or Claim 2, characterised in that an active filter (11) having an adjustable filtering frequency band is interconnected between the microphone (7) and the transmitter (15), the active filter including at least one frequency dependent negative feedback connected amplifier and/or one positive feedback connected amplifier.

6. Apparatus as claimed in Claim 5, characterised in that the active filter consists of an active band pass filter having an adjustable middle frequency in the frequency range between 10 and 100Hz.

7. Apparatus as claimed in Claim 1 or Claim 2, characterised in that the voltage source (23, 25; 33, 35) comprises a voltage multiplier circuit (25,

35) energised by a square pulse generator, the electrodes being connected to the output of said voltage multiplier circuit (25, 35).

8. Apparatus as claimed in Claim 7, characterised in that the voltage multiplier circuit (25, 35) generates a DC-voltage balanced to earth at output terminals thereof.

9. Apparatus as claimed in any of Claims 3 to 7, characterised in that the output voltage of a voltage multiplier circuit (35) is arranged to be controllable in dependence upon the amplitude of the received signal, the said amplitude representing the intensity of the snoring sound, the control to occur in a way to make the output voltage increase with increasing amplitude.

10. Apparatus as claimed in Claim 9, characterised in that the frequency of a square pulse generator (33) is controllable in dependence upon the amplitude of the received signal.

11. Apparatus as claimed in Claim 7, characterised in that the voltage source (23, 25; 33, 35) includes a manually operable adjusting member (27, 39) for setting the output voltage to values between 20 volts and 40 volts.

12. Apparatus as claimed in any of Claims 1 to 11, characterised in that each electrode has a contact surface of electrically conducting hard rubber, nickel or silver.

13. Apparatus as claimed in any of Claims 1 to 11, characterised in that the electrodes are silver/silver chloride electrodes.

14. Apparatus as claimed in any of Claims 1 to 11, characterised in that each electrode has a contact surface or porous graphite.

15. Apparatus as claimed in any of Claims 1 to 14, characterised in that the receiver and the voltage source are built into a common housing (45) provided with fastening straps (49, 51) or the like, and that the two electrodes when in use, are applied spaced and insulated from each other on the side adapted to be applied to a sleeping person.

16. Apparatus for stopping a sleeping person from snoring as claimed in Claim 1, substantially as hereinbefore described and illustrated in any of the accompanying drawings.

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